

outputs for configuring connections between the input ports and the output ports; and

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20 3. A scheduler according to claim 2 including timers that are activated anytime one of the input ports requests a connection to one of the output ports, the arbitration circuit increasing the priority for any input ports having unserviced connection requests extending beyond a timer period.

4. A scheduler according to claim 1 wherein the arbitration circuit conducts output port arbitrations for each one of the output ports and conducts input port arbitrations for each one of the input ports winning multiple output port arbitrations.

5. A scheduler according to claim 4 wherein the output port arbitrations and the input port arbitrations are conducted for both multicast packets and unicast packets for a next time slot.

6. A scheduler according to claim 1 wherein each one of the input ports has associated virtual output queues each dedicated to a different one of the output ports.

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7. A scheduler according to claim 6 wherein the arbitration circuit conducts output port arbitrations for all of the virtual output queues dedicated to the same output ports and conducts input port arbitrations between the virtual output queues for the same input port issued grants during the output port arbitrations.

8. A scheduler according to claim 7 wherein the output port arbitrations and the input port arbitrations are conducted according to both the priority and number of bytes of the packets associated with the virtual output queues.

9. A scheduler according to claim 8 including output port pointers for conducting round robin arbitrations during the output port arbitrations and input port pointers for conducting round robin arbitrations during the input port arbitrations.

10. A scheduler according to claim 9 including a cross switch that is configured by the arbitration circuit to connect the input ports to the output ports during individual time slots according to the output port arbitrations and the input port arbitrations.

11. A scheduler according to claim 1 wherein the arbitration circuit conducts a multicast arbitration that establishes connections for multicast packets during a next time slot and then conducts a unicast arbitration that establishes connections for unicast packets during the next time slot for any remaining unassigned output ports.

12. A scheduler according to claim 1 wherein the multicast arbitration and the unicast arbitration are conducted for both output port arbitrations and also for input port arbitrations.

13. A scheduler according to claim 12 wherein the arbitration circuit is programmable to vary a percentage of output ports assignable during the multicast arbitration.

14. A method for scheduling connections between input ports and output port, comprising:

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receiving requests from input port buffers for connections to the output ports during a next time slot;

identifying arbitration parameters for the requests;

conducting output port arbitrations for each one of the output ports according to the arbitration parameters;

10 issuing grants to the input port buffers winning the output port arbitrations;

conducting input port arbitrations for input ports receiving grants from the output port arbitrations;

accepting one of the grants to one of the input port buffers at each input port winning the input port arbitrations; and

15 connecting the input port buffers accepting the grants to the requested output
ports.

15. A method according to claim 14 wherein the arbitration parameters include a weight that varies according to a number of packet bytes in the input port buffers and a priority of the packets in the input port buffers.

16. A method according to claim 15 including:
selecting one of the weight and the priority to identify a first highest arbitration status;

25 using the other nonselected weight and priority to identify a second highest arbitration status for two or more input port buffers having the same first highest arbitration status; and

issuing grants to the input port buffers according to the first highest arbitration status when packet for only one input port buffer has the first highest arbitration status and issuing grants to the input port buffers according to the second highest arbitration status when two or more input port buffers have the first highest arbitration status.

17. A method according to claim 16 including using a round robin arbitration

35 when two or more input port buffers have the same first highest arbitration status and the same second highest arbitration status.

18. A method according to claim 17 including tracking how long the input

5 port buffers have waited for connections to the output ports and increasing priority for
input port buffers that have waited beyond a given threshold time period.

19. A method according to claim 14 including:

conducting a multicast arbitration for multicast packets in the input port buffers;

and

20. A method according to claim 19 including:

identifying multicast group vectors for the multicast packets;

conducting multicast input port arbitrations for identifying a highest one of the
 ast group vectors for each one of the input ports;

establishing connections for the multicast group vector winning the multicast port arbitrations.

21. A method according to claim 20 including:

accepting the grants matching the multicast group vector.

22. A method according to claim 19 including conducting a unicast
 23. transmission after the multicast arbitration.

23. A method according to claim 19 including varying a percentage of ports that can be assigned during the multicast arbitration before conducting cast arbitration.

5 virtual output buffers for temporarily storing packets assigned to the dedicated output
ports.

25. A method according to claim 14 including conducting a first round robin arbitration when multiple packets have the same highest priority and same weight during the output port arbitrations and conducting a second round robin arbitration during the input port arbitrations when multiple input port buffers for the same input ports have been issued grants during the output port arbitration and have the same highest priority and same weight.

15 26. A network processing device, comprising:
multiple input ports for receiving incoming packets;
multiple output ports for outputting packets;
a cross switch coupled to the different input ports and the different output
ports;
20 a scheduler that configures the cross switch for connecting selected ones of the
input ports to selected ones of the output ports; and
multiple virtual output buffers associated with each one of the input ports,
each one of the virtual output buffers dedicated to a different one of the output ports.

25 27. A network processing device according to claim 26 wherein the scheduler conducts a multicast arbitration before each time slot to select virtual output buffers to connect to multiple output ports, the scheduler then conducting a unicast arbitration for connecting any unselected virtual output buffers to unselected output ports.

28. A network processing device according to claim 27 wherein the scheduler conducts the multicast arbitration and the unicast arbitration both for the virtual output queues associated with the same input ports and for the virtual output queues dedicated assigned to the same output ports.

29. A network processing device according to claim 28 wherein the multicast arbitration and the unicast arbitration;
issue grants according to priority of the packets in the virtual output queues;

5 issue grants according to a number of bytes in the packets when packets for
two or more virtual output queues have a same highest priority; and
 issue grants according to a round robin order when packets for two or more
virtual output queues have the same high priority and a same number of bytes.

10 30. A network processing device according to claim 29 wherein the
multicast arbitration and the unicast arbitration determine connections between the
input ports and the output ports before each time slot.